Morgan, T. H., and Bridges, C. B.
1916. Sex-linked Inheritance in *Drosophila*. Carnegie Publication No. 237.
Morgan and Plough.
1915. Appearance of Known Mutations in other Mutant Stocks. AMER. NAT., Vol. XLIX.
Muller, H. J.
1917. An *Œnothera*-like case in *Drosophila*. *Proc. Nat. Acad. Sci.*, Vol. 3.

D. E. LANCEFIELD
COLUMBIA UNIVERSITY

EVIDENCE FROM INSULAR FLORAS AS TO THE METHOD OF EVOLUTION

EVIDENCE as to the rôle which hybridization plays in evolutionary change may be obtained from various insular floras by a comparative study of the history of those plant types in them which are prevailingly self-fertilized and those which are prevailingly cross-fertilized, both as to the rapidity with which new local species are produced and as to the frequency with which old species disappear. With these points in view, analyses have been made of the vascular plants in the floras of eight islands or island groups: Ceylon, Mauritius, Socotra, New Zealand, Hawaii, Galapagos, Juan Fernandez and St. Helena.[1] In all these there is a conspicuous, often predominant, element in the flora which is strictly local or endemic, indicating that each island has been the theater of considerable evolutionary change.

Information is necessarily lacking as to the method of fertilization of most of the species, but our general knowledge of the reproduction of the higher plants allows us to divide them into three main types. The dicotyledons and petaliferous monocotyledons, possessing floral organs which in the great majority of cases are attractive to insects, are doubtless prevailingly cross-pollinated. In the glumaceous monocotyledons, on the other hand (chiefly Gramineæ, Cyperaceæ and Juncaceæ), the floral organs are not so constructed as to favor cross-pollination, and it will probably be agreed that crossing is much less common

[1] These analyses are based on the following authorities: Trimen, Handbook of the Flora of Ceylon; Baker, Flora of Mauritius and the Seychelles; Balfour, Botany of Socotra; Cheeseman, Manual of the New Zealand Flora; Hillebrand, Flora of the Hawaiian Islands; Stewart, Botany of the Galapagos Islands; Johow, Flora de las Islas de Juan Fernandez; Melliss, St. Helena; and Hemsley, Report on the "Challenger" Expedition: Botany.

among them than in the petaliferous types. Finally, in the vascular cryptogams, the very frequent occurrence of bisexual gametophytes seems to insure a still greater prevalence of self-fertilization.

The vascular flora of each island was divided into these three groups which were studied comparatively. Determination was first made as to the percentage of local or endemic species in each group. This degree of endemism provides us with a rough measure of the extent to which new forms have been developed on the island, and thus allows us to compare the rapidity of evolution in one floral group with that in the others.[2] In the following table are set forth the percentage of endemic species in each of the three main groups which we have mentioned, and for each of the islands:

TABLE I

PERCENTAGE OF ENDEMIC SPECIES IN VARIOUS FLORAL ELEMENTS

	Ceylon	Mauritius	Socotra	New Zealand	Hawaii	Galapagos	Juan Fernandez	St. Helena
Dicotyledons and Petaliferous Monocotyledons ..... Average, 65%	35%	55%	42%	84%	84%	50%	73%	100%
Glumaceous Monocotyledons ..... Average, 38%	11	14	9	56	60	30	37	87
Vascular Cryptogams..... Average, 23%	9	20	10	30	51	2	18	44

It is evident that the proportion of endemic species is much higher among those types which we have reason to believe are prevailingly crossed than among those which are prevailingly selfed, being highest among dicotyledons, lower among glumaceous monocotyledons and lowest among vascular cryptogams. The same fact appears among genera, for 95 per cent. of the endemic genera of these islands belong to petaliferous types and only 5 per cent. to the glumaceous monocotyledons and vascular cryptogams. These facts all point to the importance of hybridization as a factor in the production of new species.

The other aspect of evolutionary change, namely the disap-

[1] Of course not all the endemic forms can be regarded as of local origin, since certain of them may be isolated relicts of types formerly more widely spread. The proportion of these, however, which have not subsequently undergone specific change, and thus developed true local types, is probably small.

pearance of species, seems also to be influenced by the method of fertilization. Many of the genera which are themselves not endemic on any island are nevertheless represented there now *only* by endemic species. In such cases it seems clear that the first representative of the genus to invade the island has since disappeared there entirely and been replaced by local species. Table II gives the percentage of such genera (not endemic but represented only by endemic species) for each of the three plant types which we have discussed and for all the islands.

TABLE II

PERCENTAGE OF THE NON-ENDEMIC GENERA WHICH ARE REPRESENTED ONLY BY ENDEMIC SPECIES

	Ceylon	Mauritius	Socotra	New Zealand	Hawaii	Galapagos	Juan Fernandez	St. Helena
Dicotyledons and petaliferous monocotyledons ..... Average, 42 %	9%	28%	29%	44%	57%	16%	52%	100%
Glumaceous monocotyledons ..... Average, 26 %	2	11	12	10	40	11	38	83
Vascular cryptogams ..... Average, 10.5 %	3	0	0	20	18	0	19	25

It is evident that genera in which the "original species" has become extinct are proportionally commonest among dicotyledons, less common among glumaceous monocotyledons and rare among vascular cryptogams, thus suggesting that hybridization has resulted in the "swamping out" of the early forms. If local adaptation and natural selection alone were at work, it is hard to see why extinction should not be equally common in all these groups. The facts point to the importance of hybridization in completely altering specific type when a group of individuals have been isolated from the main body of the species.

Against the soundness of these conclusions several points may be urged. Vascular cryptogams are perhaps inherently less variable and quick to produce new species than flowering plants. It may be, too, that cross-fertilization is much more common among them than is generally believed. Whether the recognized "species" among these plants is the equivalent of the "species" among angiosperms, or is a much more inclusive group, is also a matter of doubt. These points can not well be brought against the glumaceous monocotyledons, however, as contrasted with the petaliferous types. Whatever its interpretation, the fact seems

clear that among dicotyledons and petaliferous monocotyledons new types are produced and old types lost much more quickly than anywhere else in vascular plants, a fact which in the light of our knowledge of methods of reproduction certainly supports the view that hybridization has been a powerful factor in evolutionary change.

SUMMARY

Evidence from a comparative study of endemism in various elements of certain insular floras tends to show that among cross-fertilized types new species are developed more rapidly and old ones lost more frequently than among self-fertilized types, thus emphasizing the importance of hybridization as a factor in evolutionary change.

EDMUND W. SINNOTT

CONNECTICUT AGRICULTURAL COLLEGE

A LAND PLANARIAN FOUND AT BERMUDA[1]

IN 1902 Professor Verrill recorded ("The Bermuda Islands," p. 436, Fig. 237), that there had been reported to him the finding at Bermuda of a "worm" which appeared to be a land planarian. With the possible exception of this worm, which may have been a *Bipalium*, no land planarians have been seen at Bermuda. While collecting earthworms, in September, 1917, I obtained among moist decaying leaves in a "fertilizer pit" at Point Shares, Pembroke Parish, a single specimen of a flatworm which seems to be a species of *Geoplana*. The "pit" was in use as a dumping ground for garden refuse, and since no land planarians appear to be native to Bermuda, the worm may have been introduced in company with plants. It was 50 mm. long and 2 mm. wide, pale greenish blue on the ventral surface,—which bore a rather small oral sucker in the usual position,—the ground color of the dorsal surface being a deeper shade of the same greenish blue, but marked with two deep blue or black longitudinal stripes running the whole length of the animal. Two well-developed pigment spots were present, one on either lateral margin of the anterior end. It is not impossible that this species might become permanently colonized at Bermuda (although no other specimens have been found), and this note may therefore be of use in fixing the date of its earliest observed appearance.

W. J. CROZIER

AGAR'S ISLAND, BERMUDA

[1] Contributions from the Bermuda Biological Station for Research, No. 85.